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TRANSIT ICING TESTS WITH EARLY WHITE ROSE POTATOES FROM KERN COUNTY, CALIFORNIA, TO NEW YORK CITY, MAY AND JUNE, 1950

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TRANSIT ICING TESTS WITH EARLY WHITE ROSE POTATOES FROM KERN COUNTY, CALIFORNIA, TO NEW YORK CITY. MAY AND JUNE, 1950

A study of transit refrigeration methods for new potatoes has been underway for several years. The object is to evaluate substitutes for standard refrigeration which permit savings in costs and ice and which provide more moderate and favorable transit temperatures. The savings afforded by modified icing rules are illustrated in the accompanying table of the current charges for icing service for rail shipments from Bakersfield, California, to New York City.

Protective Service	Icing Rule Number	Refrig. Charges Full bunker	Half-stage
Standard Refrig. (re-ice daily)	200	$ 105.30	$ 82.66
Dry cars			
Initial and one re-icing	247a	64.80	50.26
Initial and two re-icings	247b	84.64	66.13
Pre-iced cars			
Replenish and one re-icing	254a	71.42	55.55
Replenish and two re-icings	254b	91.25	71.42

Cars equipped for half-stage icing have auxiliary ice grates which may be used to confine the ice to the top half of the bunker and to reduce the bunker capacity about one-half. This service, because of economies in ice supplied and transported, is available at a reduction of about 22 percent of the transcontinental rate for similar icing services with full bunker icing.

Tests with modified full bunker icing have shown that standard refrigeration is not needed for potato shipments under most conditions (see U. T. & S. Reports 189, 191, and 216); however, temperatures below 45-50° F., which are believed to be undesirable for skinned potatoes, often occur in the bottom layers of the load with the modified services. Tests in 1949 showed that half-stage icing in non-fan cars also resulted in the undesirable low temperatures in the bottom layers. Since forced air circulation within the car tends to equalize top and bottom temperatures it seemed desirable to test stage icing in fan cars.

The tests reported herein were made primarily to evaluate the combination of stage icing and air circulation under several refrigeration services. The shipments included the following protective services:

(1) Half-stage bunker, fans on

(a) Rule 200; standard refrigeration
(b) Rule 247b; initial icing and two re-icings
(c) Rule 254b; pre-ice, replenish and two re-icings

(2) Full bunker, fans on

(a) Rule 200; standard refrigeration
(b) Rule 247a; initial icing and one re-icing
(c) Rule 247b; initial icing and two re-icings
(d) Rule 254a; pre-ice, replenish and one re-icing (Precooled after loading).

Test Procedure

The general plan of investigation called for several shipping tests during the season, each consisting of 2 or 3 cars loaded on the same day and routed alike but differing in bunker capacity and in icing instructions.

Test-lots of potatoes were placed in the top doorway and bottom bunker positions of each car. They consisted of four 10-lb. mesh bags of tubers placed in the upper half of 100-lb. burlap bags. These potatoes were thoroughly composited to make the lots in the cars for a given shipping day comparable and they were used to determine the effect of the different icing methods on weight loss and browning of the skinned areas in transit and during a holding period at the market.

Records of the transit temperatures at the top doorway, middle quarter, and bottom bunker positions of each car were obtained with Ryan recording thermometers placed inside the bags of potatoes.

All loads consisted of washed White Rose potatoes packed in 100-lb. burlap bags. The bottom bags were set on individual excelsior floor pads to minimize transit bruising. Test cars Nos. 1 to 9, inclusive, (Table 1) contained pyramid or log cabin loads of 360 bags and cars 10 to 12 were 3 X 5 bumped loads of 400 bags. All cars loaded on the same day were loaded similarly.

A record of the amount of ice supplied to the cars between Bakersfield, California, and Council Bluffs, Iowa, was obtained from the railroad files. Only those test cars shipped under standard refrigeration were iced beyond Council Bluffs.

All cars were routed S.P., U.P. to Council Bluffs and over connecting lines to New York City via Chicago, Illinois.

Results

Direct comparisons of the results obtained under the several refrigeration services may be made of the cars within each of the four tests.

Test A, shipped May 5

This test consisted of three cars forwarded with fans on, as follows:

Car #1: Full bunkers; standard refrigeration.

Car #2: Full bunkers; initially iced at Bakersfield and re-iced once in transit at Council Bluffs, Iowa (Rule 247a).

Car #3: Half-stage bunkers; initially iced at Bakersfield and re-iced twice in transit at Sparks, Nevada, and Council Bluffs, Iowa (Rule 247b).

Temperature

The temperature records for these cars are shown in Fig. 1. Because of relatively low temperatures of the potatoes when loaded (55° to 60° F.), the top and middle layers of the loads cooled to 50° in about 48 hours, with bottom layer bags reaching this point in 24 hours or less. Thereafter, continued cooling resulted in temperatures of 36 to 39° in top layers, 36 to 37° in middle layers, and 35 to 38° in bottom layers. The transit temperatures occurring under rule 247 were only slightly warmer than those under standard refrigeration. All services provided more than adequate refrigeration and cooled the potatoes more than necessary.

Ice used

Test car 1 under standard refrigeration was re-iced daily with 1,000 to 2,000 pounds of ice during the 5 days en route to Council Bluffs, Iowa. Test car 2, initially iced at Bakersfield, had about 1,300 pounds of ice remaining in the bunkers before re-icing at Council Bluffs and arrived at New York City with the bunkers one-half full. The quantities of ice supplied indicate that the half stage bunkers of car 3 were nearly depleted of ice before re-icing at both Sparks and Council Bluffs. Upon arrival at New York City six days after the final re-icing, about one ton of ice remained in each end of the car. The amounts of ice supplied initially and during re-icing are shown in Table 2.

Weight loss and browning

The test lots of potatoes in these cars were rather immature and, consequently, severely skinned. The weight losses were similar in the three cars. They ranged from .8 to 2.7 percent and averaged 1.7 percent during the transit period; after holding for 2 days at market conditions, the total losses ranged from 2.0 to 5.5 percent and averaged 4.4 percent (See Table 3).

The browning of the skinned areas of the potatoes during the transit period for all three cars was considered to be insignificant since it amounted to only 0 to 4.4 percent (Table 4). Six days after unloading, the quantity of browning on potatoes from the top doorway positions ranged from 2.6 to 8.3 percent and averaged 5.6 percent; whereas, potatoes from the bottom bunker positions had 6.1 to 8.4 percent browning with an average of 7.4 percent. Severe browning, as judged by appearance of a darker color than snuff brown of Ridgway plate XXIX, was also more prevalent on potatoes from the bottom bunker positions than on those from the top doorway positions at the end of the holding period. This effect was probably due to the more rapid cooling and slightly lower carrying temperatures at the bottom bunker than at the top doorway. There were no apparent differences in browning for the three protective services employed in this test and it is probable the transit temperatures in all cars were too low for good development of normal new skin thick enough to prevent browning.

Test B, shipped 5/12 and 5/13

The protective services of cars 5 and 6 of this test were the same as of cars 2 and 3 of Test A. Loading of car 5, iced according to full bunker rule 247a, initially iced at Bakersfield and re-iced once in transit at Council Bluffs, was begun May 12 and completed the following day. Car 6 was shipped May 12 under half stage rule 247b, initially iced at Bakersfield and re-iced twice in transit at Sparks and Council Bluffs. Although these cars were shipped one day apart, it is believed the weather conditions during the loading and transit periods were similar. Both cars were shipped with the fans on.

Temperature

The transit temperatures shown in Figure 2 do not include the holding period of car 5 prior to noon May 13 since there was little change in the temperature of the potatoes during the prolonged loading period. Both cars were initially iced the next morning after completion of loading or the first day in transit.

Due to warmer potatoes at time of loading (68° to 72°) and to warmer weather enroute in this test as compared to Test A, it took 3-1/2 days for the top and middle layers of the loads to cool to 50° (Fig. 2). Potatoes at the bottom bunker position cooled rapidly in the full bunker car and reached this temperature in 24 hours, whereas those in the half stage bunker car were above 50° for 3 days.

There was a temperature increase of several degrees in car 5 (full bunker) before it was re-iced at Council Bluffs. Apparently the ice supply was depleted about 2 days before re-icing. The transit temperatures indicate both protective services were adequate for new potatoes under these loading and transit conditions.

Ice used

Car 5, with full bunker icing under rule 247a, was initially iced at Bakersfield and required an amount equal to the rated bunker capacity when re-iced at Council Bluffs. It arrived at New York City with the bunkers 3/8 full. Car 6, with half stage icing under rule 247b, was initially iced at Bakersfield and required a near capacity amount (6200 pounds) at Sparks, Nev., and an additional 4000 pounds at Council Bluffs, Ia. It arrived with about 300 pounds of ice in each end of the car. The quantities of ice melted are summarized in Table 2.

Weight loss and browning

The test potatoes in these cars were as severely skinned as those of the former test and in addition were infected with some surface scab. Weight losses were greater than in the former test. They ranged from 2.1 to 4.7 percent and averaged 3.6 percent in transit and ranged from 4.8 to 9.7 percent and averaged 6.2 percent two days after arrival. These data do not indicate to what extent the higher transit temperatures were responsible for the greater losses since the presence of surface scab may have influenced the loss in weight. Although the weight losses were less in the half stage car than in the full bunker car, the differences were too small to be considered of importance.

Some slight browning occurred in transit in this test but severe browning did not develop until after the potatoes were held at market conditions for several days after unloading. There were no consistent differences in the amount of browning between the cars iced in different ways or between the different positions in the loads (Table 4).

Test C, shipped 5/24

In this test, half stage icing under rule 247b (Car 7) was again compared with full bunker icing under rule 247a (Car 8). A third car (Car 9) was pre-iced to full bunker capacity and the potatoes were precooled 7 hours in the car before shipping. Precooling was accomplished with electric motors attached to the car fan equipment and without the use of salt to lower the air blast temperature. The bunkers in this car were replenished at the first icing station (Fresno) and re-iced at Council Bluffs, under rule 254a. All cars moved with the fans in operation.

Temperature

Loading temperatures at this date were similar to those of Test B (65° to 70°) and cars 7 and 8 cooled nearly alike with slightly higher temperatures occurring in the half stage car 7. As shown in Figure 3, the top and middle layer bags required 3 to 3-1/2 days to cool to 50°, whereas the bottom layer bags reached with temperature 1 to 2 days earlier. In the precooled car the temperature of the potatoes ranged from 55° to 60° at the conclusion of precooling and subsequent cooling enroute was faster than in the other cars; the

temperature dropped to near 35° in the bottom layer bags as compared to 40° to 45° in the non-precooled cars. Lower temperatures than necessary were attained in the three cars of this test.

Ice used

Car 7, initially iced to half stage capacity of 5,000 pounds at noon of the first day in transit, required 4,000 pounds to refill the bunkers at Sparks, Nev., about 27 hours later (Table 2). The bunkers were "dry" at the next re-icing point, Council Bluffs, Ia., but the depletion of ice resulted in only a slight rise in temperature of the potatoes. Upon arrival at the market there was only a small amount of ice remaining in each bunker. Full bunker car 8 was initially iced with 9,600 pounds at Fresno and arrived at Council Bluffs with the bunkers empty; there was, however, no appreciable rise in temperature upon depletion of the ice supply. This car was re-iced at Council Bluffs with 9,600 pounds and arrived at New York City 3 days later with the bunkers 1/4 full of ice. Stage iced car 7 was supplied with approximately 5,000 pounds less ice than the full bunker car between Bakersfield and Council Bluffs and maintained essentially the same temperature in transit. Similar results may be noted in Table 2 for the two earlier tests.

Car 9 was pre-iced with 11,200 pounds of ice on the day before loading and was replenished to full capacity with 5,000 pounds on the day after loading. This ice meltage (5,000 pounds) represents the quantity used to initially cool the car walls, remove about 13 degrees of heat from the load during and after precooling, and to absorb heat leakage into the car for a period of about 2 days during hot weather. Meltage between Fresno and Council Bluffs, the re-icing points, amounted to 9,800 pounds of ice. The car arrived at New York City with the bunkers 3/8 full.

Weight loss and browning

Weight losses of the test potatoes were about the same in this test as in Test A although there was slightly less skinning of the tubers. The losses ranged in amount from 1.2 to 3.2 percent and averaged 2.0 in transit; and from 1.8 to 5.0 percent for an average of 3.7 after two days at the market. As in the prior tests, the slightly smaller losses with half stage icing are considered to be of little significance and indicate the need for further tests of this point. The weight losses of the test samples in the precooled car were similar to those of the non-precooled cars.

The potatoes of this test were first inspected for browning after a 7-day holding period at market conditions. There was considerable slight browning on potatoes from cars 7 and 8 (range, 14.9 percent to 27.4 percent), but very little severe browning (.4 percent to 2.6 percent, Table 4). There was little difference due to the half stage and full bunker icing used with these cars; there was, however, more browning on potatoes from the bottom bunker positions than on those from the top doorway positions of the two loads. Severe browning (10.5 percent) occurred on the potatoes from the top doorway position of the precooled car, but further tests are needed to determine if there was wind injury during the precooling operation.

Test D, shipped June 29

Test D was made during hot weather with three modified refrigeration services of similar cost that afforded a comparison of loading in pre-iced and non-pre-iced cars. Cars 10 and 11 were equipped with half stage bunkers and were initially iced prior to loading. Car 10 moved under standard refrigeration, whereas Car 11 was replenished at Bakersfield and re-iced at Carlin and Council Bluffs under rule 254b. Car 12 was loaded prior to initial icing to full bunker capacity at Bakersfield. It was re-iced at Carlin and Council Bluffs under full bunker rule 247b.

Temperature

Potato temperatures at loading ranged from 75° to 82° F. A comparison of pre-iced Car 11 with non-pre-iced Car 12 in Figure 4 shows that 4 days were required in both instances to cool the top and middle layers of the loads to 50°. However, pre-icing accomplished about 10 degrees of cooling in these layers in Car 11 before Car 12 was initially iced. The potatoes in Car 12 did not cool and remained at about 80° during this interval of time between loading and initial icing even though ventilation was provided through the open hatches. The greatest difference in these two cars occurred in the bottom layers of the loads where the temperature dropped to nearly 50° in pre-iced Car 11 in about 12 hours after loading, while 36 hours was required for similar cooling in non-pre-iced Car 12. Pre-icing to obtain rapid cooling of "weak" stock in hot weather may be desirable but dry-car loading with icing according to full bunker rule 247b, as used with Car 12, gave adequate refrigeration in transit for these potatoes.

The cooling rates of the loads in the two pre-iced cars were similar the first day or so after loading, thereafter the car under standard refrigeration (Car 10) cooled more rapidly than the car under rule 254b (Car 11). In Figure 4 it may be seen that a temperature of 40° was attained in the bottom layer of Car 10 in 3 days, whereas 40° was not reached until the 8th day in Car 11. The fast cooling and low transit temperature provided by standard refrigeration in the pre-iced half stage car was not necessary for potatoes and may be undesirable under some circumstances.

Ice used

Car 11, which was pre-iced to half stage capacity of 6,500 pounds, required 5,500 pounds of ice to replenish the bunkers on the morning after loading. All of this ice was then melted during the 60-hour run from Bakersfield to Carlin prior to the first re-icing in transit. During the 3-day run from Carlin to Council Bluffs, Ia., the final re-icing station, 5,700 pounds of ice were melted and from Council Bluffs to time of unloading 8 days later all but a trace (100 lbs.) of ice was used (Table 2).

Car 12, a dry-car load, was initially iced at Bakersfield with 11,500 pounds. A full bunker load was supplied at the first re-icing station (Carlin) 3 days later, and 9,800 pounds at the second and final re-icing station (Council Bluffs) after an additional 3 days enroute. This car was held 5 days on track

at the market without re-icing and the bunkers were 1/4 full 12 days after the final re-icing at Council Bluffs. The depletion of ice between re-icing stations did not cause a material rise in temperature of the loads of either Car 11 or 12. Stage iced Car 11 was supplied four tons less ice than full bunker Car 12 and essentially similar load temperatures were maintained in transit.

Pre-iced, half-stage Car 10 shipped under standard refrigeration was supplied with 27,000 pounds of ice or about three tons less than the amount supplied full bunker Car 12 shipped under rule 247b, but the daily re-icing of Car 10 avoided a break or lag in the cooling of the load due to a depleted ice supply. This resulted in a steady cooling of the potatoes until the minimum carrying temperatures of 35° to 40° were attained.

Weight loss and browning

The test potatoes in these cars were slightly to moderately skinned. The weight losses in transit were about the same as in the former tests, however, after two days at the market the losses were somewhat less probably because of less skinning and their better maturity than the potatoes shipped earlier in the season. Weight losses after 2 days at the market ranged from 2.2 to 4.0 percent and averaged 3.2 percent (Table 3). There were no differences in weight losses attributable to the different methods of icing the cars in this test or to the location of the potatoes in the loads. This is probably a result of the low transit temperatures that prevailed in all cars of this test.

At this time, the amount of slight browning ranged from 9.4 to 24.9 percent and the severe browning amounted to 4.2 to 12.5 percent. Browning in the top and bottom layers was similar for all cars. There was a slightly greater amount of browning in Car 10 than in Cars 11 and 12 and this may have resulted from chilling in transit due to the sustained temperatures of 35° - 40° which occurred with standard refrigeration.

Commercial Considerations

These tests show that Kern County White Rose potatoes can be shipped successfully during the early season (May) in fan cars not pre-iced, using either full bunker icing rule 247a (initial and one re-icing) or half-stage icing rule 247b (initial and two re-icings). Transit temperatures obtained with these modified icing services were substantially the same as those in similar loads shipped under full bunker standard refrigeration.

Later during hot weather (June 29) icing according to half-stage rule 254b (pre-iced, replenished, two re-icings), fans on, and full bunker rule 247b (initial ice after loading, two re-icings), fans on, provided adequate protection in transit. The somewhat faster cooling of the potatoes in the pre-iced cars furnished under rule 254 may be desirable for weak stock but was not necessary for the potatoes shipped in these tests.

Precooling the loads or pre-icing the cars had an immediate effect upon removing the field heat from the potatoes but further tests are needed to determine whether or not fast cooling is of any benefit during normal weather.

Stage icing with fan cars did not sustain transit temperatures of 50° as hoped, but cooled the loads about the same as full bunker icing. In either case, to avoid low temperatures in transit it was necessary to allow the bunkers to "run dry" at intervals by delaying re-icing one or two days beyond the points where the ice supply was depleted.

Losses in weight of slight to severely skinned potatoes in these tests amounted to about 2 percent in transit. The differences in weight losses during the transit period between the early and late season shipments were small, but after 2 days at the market the early season, severely skinned stock showed 5 percent shrinkage compared with 3 percent for late season, slightly skinned tubers. Similar losses of early and late season potatoes occurred in the tests made in 1948 (H. T. & S. Office Reports 189 and 191).

Surface browning detracts from the appearance of the potatoes and is thought to be due largely to failure of the skinned areas to heal normally at low temperature. It was of little consequence in these tests at the time the potatoes were removed from the car, but developed after removal and increased in intensity of objectionable darkening during a 6 to 8 day holding period at the market. Browning was more prevalent in stock removed from the bottom bunker position of the load than in that from the top doorway. The bottom bunker position is usually the coldest in transit. The small differences in browning between the different protective services employed in these tests are attributed to the relatively low transit temperatures obtained under all the icing rules tested.

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Table 1. Test Cars and Protective Services; Kern County Early Potatoes, 1950.

No.	Test Car [2]	Date Shipped	Shipping Point, [3] Calif.	Protective Service [1]	Rule [4]
1.	PFE 48652	5/5	DiGiorgio	FB:D: Iced at all regular stations (Standard refrigeration)	200
2.	PFE 3265	do.	do.	FB:D: Iced at Bakersfield, Calif., and Council Bluffs, Iowa.	247a
3.	PFE 6354	do.	do.	HS:D: Iced at Bakersfield, Sparks, Nev., and Council Bluffs.	247b
4.	Omitted				
5.	PFE 46770	5/12	DiGiorgio	FB:D: Iced at Bakersfield and Co. Bluffs.	247a
6.	PFE 66862	do.	do.	HS:D: Iced at Bakersfield, Sparks, and Council Bluffs.	247b
7.	ART 27488	5/24	JoVista	HS:D: Iced at Fresno, Calif., Sparks, and Council Bluffs.	247b
8.	FGE 39601	do.	do.	FB:D: Iced at Fresno and Council Bluffs.	247a
9.	SFRD 10200	do.	do.	FB:PI:PC: Iced at Fresno and Council Bluffs.	254a
10.	PFE 4279	6/29	Wible	HS:PI: Iced at all regular stations (Std. Refrig.)	200
11.	PFE 6959	do.	do.	HS:PI: Iced at Bakersfield, Carlin, Nev., and Council Bluffs.	254b
12.	PFE 7438	do.	do.	FB:D: Iced at Bakersfield, Carlin, and Council Bluffs.	247b

1/ FB: Full bunker icing; HS: Half-stage icing; D: Dry-car load (loaded before icing); PI: Pre-iced car (iced before loading); PC: Load precooled in the car.

2/ All cars were equipped with Preco fans.

3/ Routing: S.P., U.P. and connecting lines to Chicago, Ill, and Jersey City, N. J.

4/ All cars forwarded with fans "on".

Table 2. Ice Supplied Test Cars Between Bakersfield, Calif., and Council Bluffs, Ia.

Test Car	1	2	3	5	6	7	8	9	10	11	12
Date Shipped	5/5	5/5	5/5	5/12	5/12	5/24	5/24	5/24	6/29	6/29	6/29
Bunker	Full	Full	Stage	Full	Stage	Stage	Full	Full	Stage	Stage	Full
Icing Rule	200	247a	247b	247a	247b	247b	247a	254a	200	254b	247b
Pre-ice (Lbs.)	None	None	None	None	None	None	None	11,200	6,500	6,500	None
Replenish (Lbs.)	None	None	None	None	None	None	None	5,000	4,500	5,500	None
Initial (Lbs.)	11,500	11,500	6,500	11,500	6,500	5,000	9,600	-	-	-	11,500
Re-ice (Lbs.)											
Sparks, Nev.	2,800[1]	-	5,000	-	6,200	4,000	-	-	-	-	-
Carlin, Nev.	-	-	-	-	-	-	-	-	9,600[1]	6,500	11,500
Co.Bluffs, Ia.	4,600[1]	10,200	5,400	11,500	4,000	5,000	9,600	9,800	6,400[1]	5,700	9,800
Total ice incl. Council Bluffs re-icing (Lbs.)	18,900	21,700	16,900	23,000	16,700	14,000	19,200	26,000	27,000	24,200	32,800
Ice remaining at market	3/4 full	1/2 full	4,000 lbs.	3/8 full	600 lbs.	300 lbs.[2]	1/4 full[2]	3/8 full	5,000 lbs.	100 lbs.	1/4 full[3]

1/ Ice supplied at station designated plus amounts added at intermediate stations.

2/ Re-iced at the market for holding on track.

3/ After 5 days on track at market.

Table 3. Weight Loss of Potatoes Shipped Under Different Protective Services.

Test Car No.	Date Shipped	Protective Service[1]	Loss in Weight of 4, 10-lb. Bags								Remarks
			In Transit				After 2 days at market				
			Top Door		Bottom Bunker		Top Door		Bottom Bunker		
			Range pct.	Ave. pct.	Range pct.	Ave. pct.	Range pct.	Ave. pct.	Range pct.	Ave. pct.	
1	5/5	FB:R200	1.4-2.2	1.7	1.2-2.5	1.9	2.0-4.4	3.4	4.8-5.5	5.1	Severely skinned
2	do.	FB:R247a	1.2-2.7	2.0	1.4-2.1	1.9	2.2-5.2	4.2	4.0-5.2	4.7	do.
3	do.	HS:R247b	1.4-2.0	1.7	.8-1.8	1.4	4.3-5.3	4.9	3.3-4.7	4.0	do.
5	5/12	FB:R247a	4.0-4.7	4.4	3.7-4.5	4.1	6.0-7.0	6.5[2]	6.1-9.7	6.9[2]	(Severely skinned,
6	do.	HS:R247b	3.2-4.0	3.4	2.1-3.3	2.7	5.6-6.5	5.9[2]	4.8-6.2	5.5[2]	(some surface scab.
7	5/24	HS:R247b	1.2-3.1	2.0	1.3-1.9	1.7	2.8-4.2	3.4[3]	2.9-3.9	3.5[3]	Moderately skinned
8	do.	FB:R247a	1.8-3.2	2.7	1.6-2.4	1.8	3.4-5.0	4.0[3]	3.3-4.4	3.8[3]	do.
9	do.	FB,PI,PC:R254a	1.8-2.2	1.9	1.6-1.8	1.7	3.3-4.1	3.8[3]	1.8-5.0	3.7[3]	do.
10	6/29	HS:PI:R200	1.6-2.5	2.1	2.1-2.6	2.4	2.5-3.5	3.2	3.3-4.0	3.7	Slightly skinned
11	do.	HS:PI:R254b	1.9-2.6	2.1	1.4-2.2	1.8	3.0-3.8	3.4	2.7-3.5	3.1	do.
12	do.	FB:R247b	1.6-2.7	2.1	1.0-1.4	1.2	2.7-3.9	3.2	2.2-2.8	2.6	do.

1/ FB: Full bunker; HS: Half-stage; PI: Pre-iced car; PC: Load precooled in car; all cars with "Fans On"; see Table 1 for icing instructions designated by R (rule) number.

2/ Lost 2½ to 3% weight during the next 6 days at the market.

3/ Lost 1½ to 2% weight during the next 6 days at the market.

Table 4. Surface Browning of Potatoes With Different Protective Services.

Test Car No.	Date Shipped	Protective Service 1/	Browning								Remarks
			In Transit				After 6 to 8 days at market				
			Top Door		Bottom Bunker		Top Door		Bottom Bunker		
			Slight	Severe	Slight	Severe	Slight	Severe	Slight	Severe	
			pct.	pct.	pct.	pct.	pct.	pct.	pct.	pct.	
1	5/5	FB:R200	4.4	0	.6	0	5.8	0	8.4	1.2	Severely skinned
2	do.	FB:R247a	2.2	0	0	0	2.6	1.5	6.1	1.2	do.
3	do.	HS:R247b	2.3	0	0	0	8.3	0	7.7	2.6	do.
5	5/12	FB:R247a	11.9	0	8.2	0	32.1	2.9	10.5	3.8	Severely skinned
6	do.	HS:R247b	12.1	0	1.9	0	13.0	2.9	49.8	2.5	do.
7	5/24	HS:R247b	-	-	-	-	16.0	.4	20.0	.8	Moderately skinned
8	do.	FB:R247a	-	-	-	-	14.9	2.4	27.4	2.6	do.
9	do.	FB,PI,PC: R254a	-	-	-	-	21.5	10.5	27.5	3.8	do.
10	6/29	HS,PI:R200	-	-	-	-	24.9	12.5	23.8	9.2	Slightly skinned
11	do.	HS,PI:R254b	-	-	-	-	21.6	6.0	9.4	7.5	do.
12	do.	FB:R247b	-	-	-	-	23.2	7.8	21.9	4.2	do.

1/ FB: Full bunker; HS: Half-stage; PI: Pre-iced car; PC: Load precooled in car; all cars with "Fans On"; see Table 1 for icing instructions designated by R (rule) number.

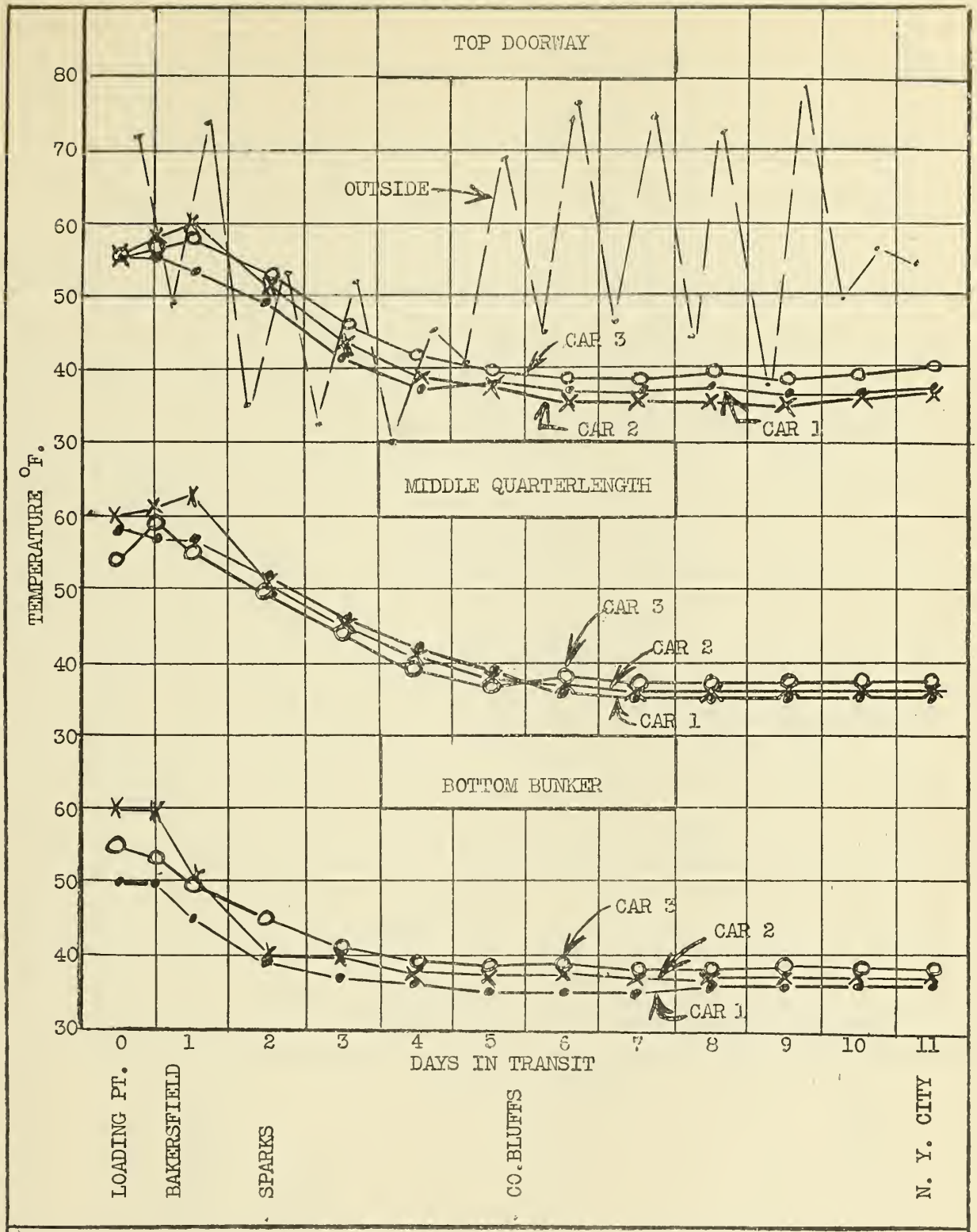

FIGURE 1 COMPARISON OF TRANSIT TEMPERATURE OF POTATOES IN:

TEST CAR 1. FULL BUNKER, STD. REFRIG., FANS ON;
TEST CAR 2. FULL BUNKER, INITIAL ICE BAKERSFIELD, RE-ICE COUNCIL BLUFFS, RULE 247a, FANS ON;
TEST CAR 3. HALF STAGE, INITIAL ICE BAKERSFIELD, RE-ICE SPARKS AND COUNCIL BLUFFS, RULE 247b, FANS ON.

BAKERSFIELD, CALIF., TO NEW YORK CITY, MAY 5,1950, S.P.,U.P.,C.&N.W.,PENNA.

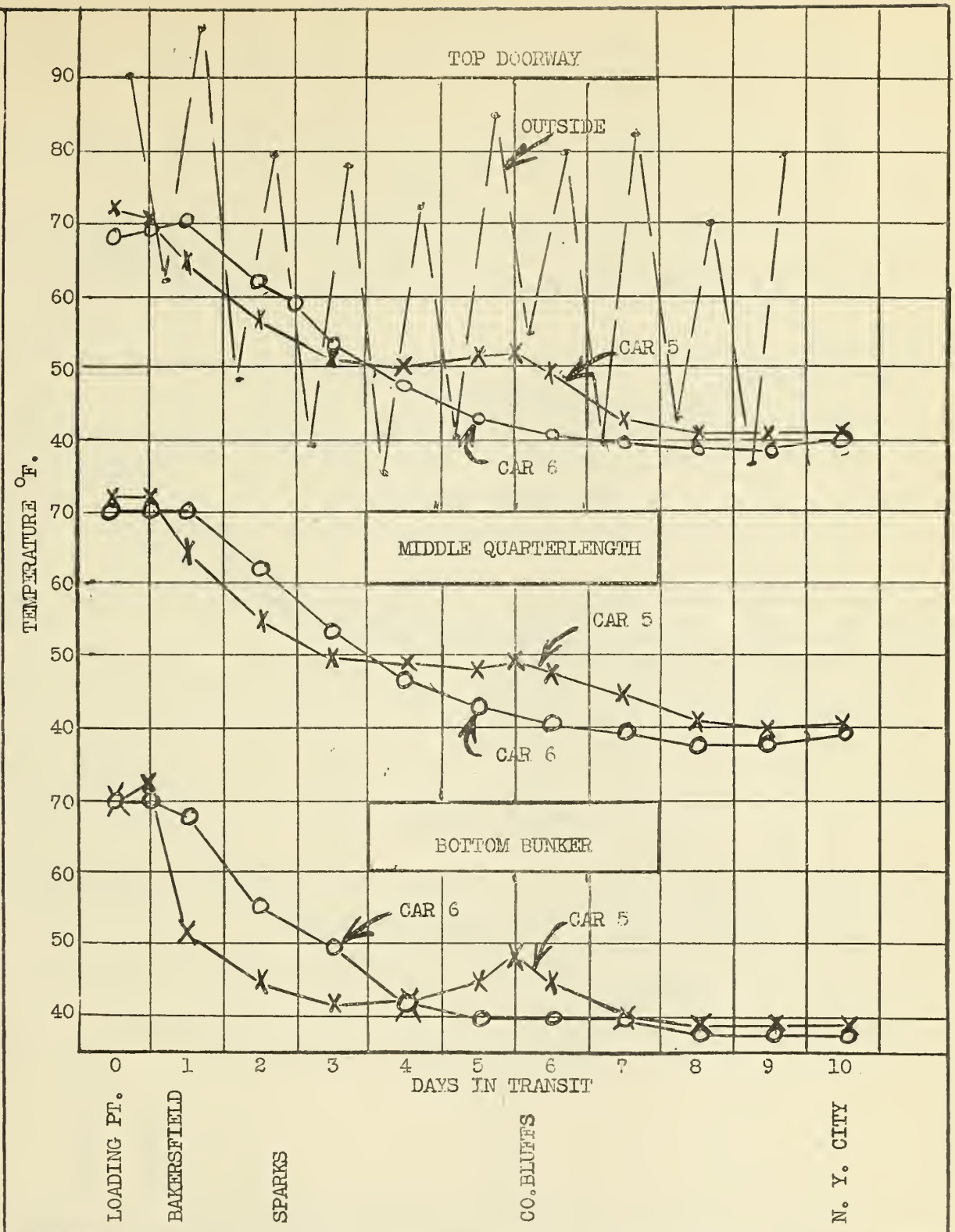

FIGURE 2 COMPARISON OF TRANSIT TEMPERATURE OF POTATOES IN:

TEST CAR 5. FULL BUNKER, INITIAL ICE BAKERSFIELD, RE-ICE COUNCIL BLUFFS, RULE 247a, FANS ON;

TEST CAR 6. HALF STAGE, INITIAL ICE BAKERSFIELD, RE-ICE SPARKS AND COUNCIL BLUFFS, RULE 247b, FANS ON.

BAKERSFIELD, CALIF., TO NEW YORK CITY, MAY 12, 1950, S.P.,U.P.,C.&N.W.,ERIE.

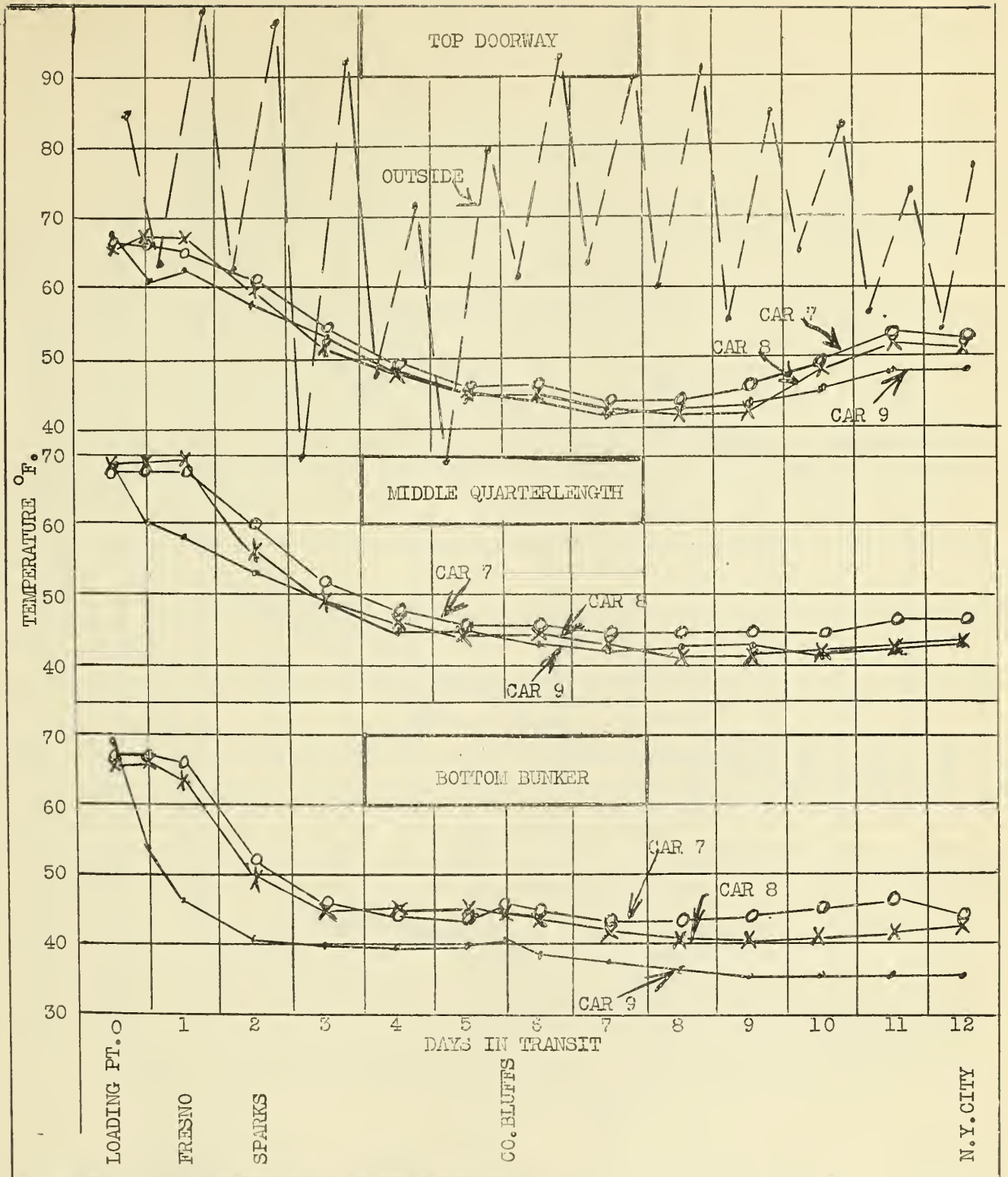

FIGURE 3 COMPARISON OF TRANSIT TEMPERATURE OF POTATOES IN:

TEST CAR 7. HALF STAGE, INITIAL ICE FRESNO, RE-ICE SPARKS AND COUNCIL BLUFFS, RULE 247b, FANS ON;

TEST CAR 8. FULL BUNKER, INITIAL ICE FRESNO, RE-ICE COUNCIL BLUFFS, RULE 247a, FANS ON;

TEST CAR 9. FULL BUNKER, PRE-ICE, REPLENISH FRESNO, RE-ICE COUNCIL BLUFFS, RULE 254a, FANS ON. LOAD PRECOOLED IN CAR.

DELANO, CALIF., TO NEW YORK CITY, MAY 24, 1950, S.P.,U.P.,C.& N.W.,PENNA.

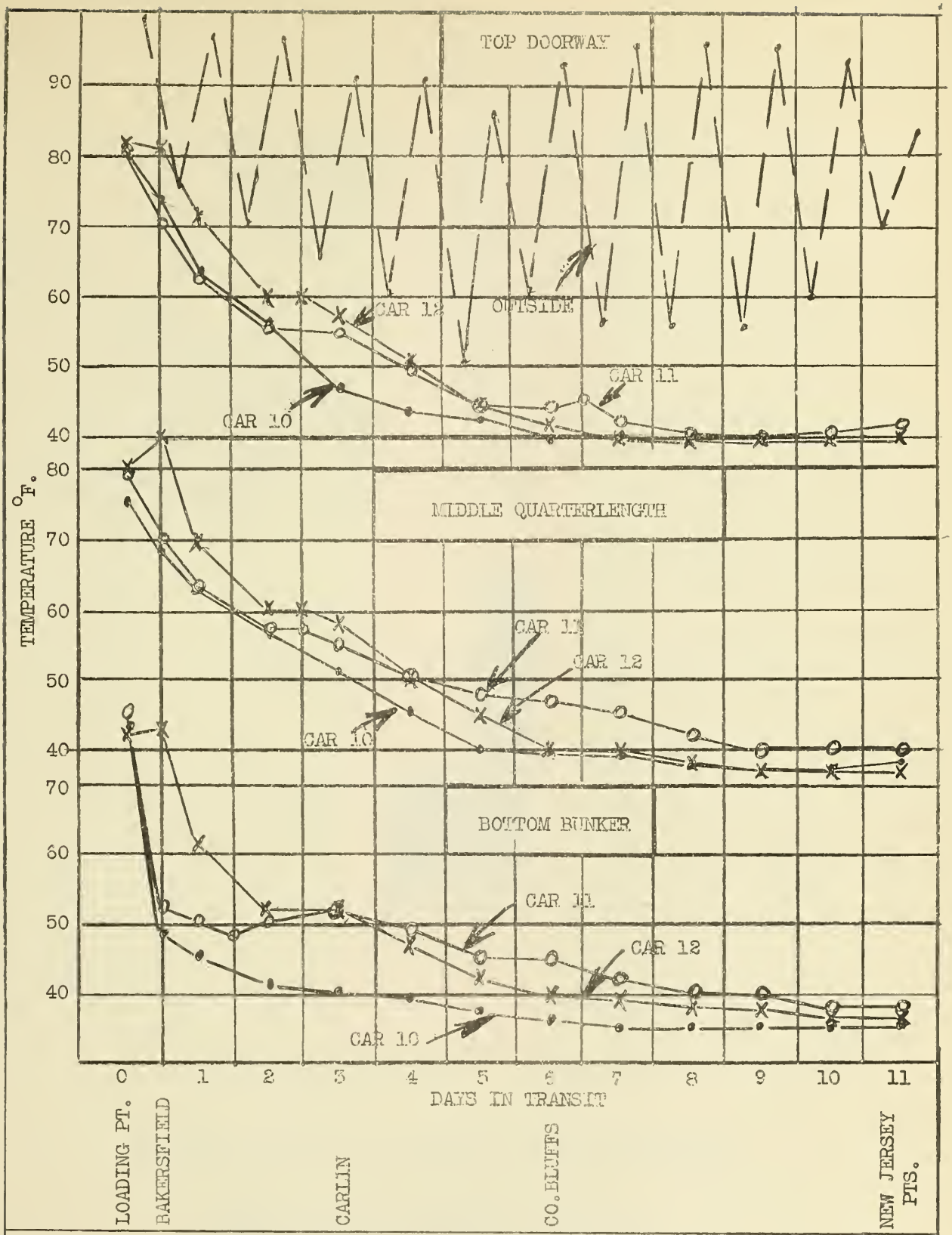

FIGURE 4 COMPARISON OF TRANSIT TEMPERATURE OF POTATOES IN:

TEST CAR 10. HALF STAGE, PRE-ICE, STD. REFRIG., RULE 200, FANS ON;

TEST CAR 11. HALF STAGE, PRE-ICE, REPLENISH BAKERSFIELD, RE-ICE CARLIN AND COUNCIL BLUFFS,, RULE 2645, FANS ON;

TEST CAR 12. FULL BUNKER, INITIAL ICE BAKERSFIELD, RE-ICE CARLIN AND COUNCIL BLUFFS, RULE 2475, FANS ON.

BAKERSFIELD, CALIF., TO TRENTON, N.J., JUNE 29,1950, S.P.,U.P.,CB&Q,TPW,PENNA.